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Documentation of Slug Tests Conducted at PSC 47, Jacksonville Naval Air Station, Jacksonville, Florida

U.S. Geological Survey

Prepared in cooperation with Southern Division Naval Facilities Engineering Command Environmental Technical Support Branch

Tallahassee, Florida 2003

Documentation of Slug Tests Conducted at PSC 47, Jacksonville Naval Air Station, Jacksonville, Florida

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SUMMARY OF SLUG TEST RESULTS:

Monitoring Well	Well Depth, in ft	Screen Length, in ft	Hydraulic Conductivity, in ft/day
MW13S	14.5	10	4
MW13D	49.0	5	3
MW15S	13.0	10	7
MW15D	47.0	5	3
MW16S	13.0	10	4
MW16D	41.5	5	0.8
MW17S	12.5	10	3
MW17D	42.0	5	0.6
MW18S	14.0	10	3
MW18D	46.0	5	0.3
MW19S	12.5	10	4
MW20I	25.0	5	3
MW23S	15.0	10	4
MW24D	15.0	5	7
MW25S	14.0	10	3
MW26S	13.0	10	4
MW27S	13.0	10	3

INTRODUCTION

Slug tests were performed on 17 monitoring wells located at PSC 47 of the Jacksonville Naval Air Station, Jacksonville, Florida. PSC 47 is a contaminated site and the contamination consists of pesticides and some chlorinated solvents. A description of the wells used for the slug testing is given in table 1, and the well locations are shown on figure 1. The purpose of the slug testing was to determine the hydraulic conductivity of the surficial aquifer at this site.

Table 1. Well characteristics and slug test results.

[a: falling head slug tests are not applicable when the water table intersects the well screen; b: the discrepancy between the theoretical displacement calculated from the slug volume and well diameter was greater than 20 percent of the observed displacement in the well.]

Monitoring Well	Depth, in ft	Screen Length, in ft	Hydraulic Conductivity From Falling Head Test, in ft/day	Hydraulic Conductivity From Rising Head Test, in ft/day	Recommended Hydraulic Conductivity, in ft/day
MW13S	14.5	10	na ^a	4	4
MW13D	49.0	5	3	3	3
MW15S	13.0	10	na ^a	7	7
MW15D	47.0	5	3	3	3
MW16S	13	10	na ^a	4	4
MW16D	41.5	5	0.8	0.8	0.8
MW17S	12.5	10	na ^a	3	3
MW17D	42.0	5	0.6	0.5	0.6
MW18S	14.0	10	na ^a	3	3
MW18D	46	5	0.3	0.3	0.3
MW19S	12.5	10	3^a	4^{b}	4
MW20I	25.0	5	2	3	3
MW23S	15.0	10	4	4 ^b	4
MW24D	10	5	7	7	7
MW25S	14.0	10	na ^a	3	3
MW26S	13.0	10	na ^a	4	4
MW27S	13.0	10	na ^a	3	3

The surficial aquifer at the site consists of a combination of interbedded fine sands, silts, and clays (figure 2). It also contains the water table. Underlying the surficial aquifer is the very low permeability Hawthorn Formation. The lithology logs for all the wells are contained in Appendix A.

During the slug testing water levels were measured using Solinst Levelogger series pressure transducers and were checked periodically by hand measurements using an electric tape. The slug tests were analyzed using a spreadsheet based program documented by Halford and Kuniansky (2002) using the Bower and Rice method (1976).

The field procedure for all the tests was as follows: 1) the pressure transducer was installed in the well and allowed to equilibrate for about 10 minutes, 2) the slug was lowered into the well, 3) water levels were collected until the water level in the well returned to the original water level [resulting in a falling-head slug test], 4) the slug was pulled out of the well [resulting in a rising-head slug test] and water levels were collected until the original water level was reached, 5) the pressure transducer was removed from the well and the data were downloaded to a laptop computer. The sampling rate for the transducer was 1 second for almost all the tests. However, a few of the tests used a sampling rate of 5 seconds because they had slow recovery rate. The data are contained on a CD-ROM disk accompanying the report.

SLUG TEST RESULTS AND DISCUSSION

The horizontal hydraulic conductivities determined for the water table wells are shown in figure 3, and the conductivities for the deeper confined wells are shown in figure 4. All of the slug test information and results are shown in figures 5 through 30; the figures are presented by ascending well number although they are not discussed in this order. In the shallow wells, where the water-table intersects the well screen, falling head tests are not applicable because water will flow into the vadose zone and this will result in a calculated hydraulic conductivity that is too high (Bouwer, 1988).

In general the slug test analysis was relatively simple, a straight line was fitted to the slope of the measured data and the program calculated the horizontal hydraulic conductivity based on the Bower and Rice method (1976). The sand pack in some of the water table wells extended above the standing water level in the well. The result of this construction was that the sand pack filled and drained with each test for these wells. Evidence of this can be clearly seen on the data from well MS16S (figure 11). The uniformly sloping data during the first 20 seconds of the test was the sand pack draining; the second

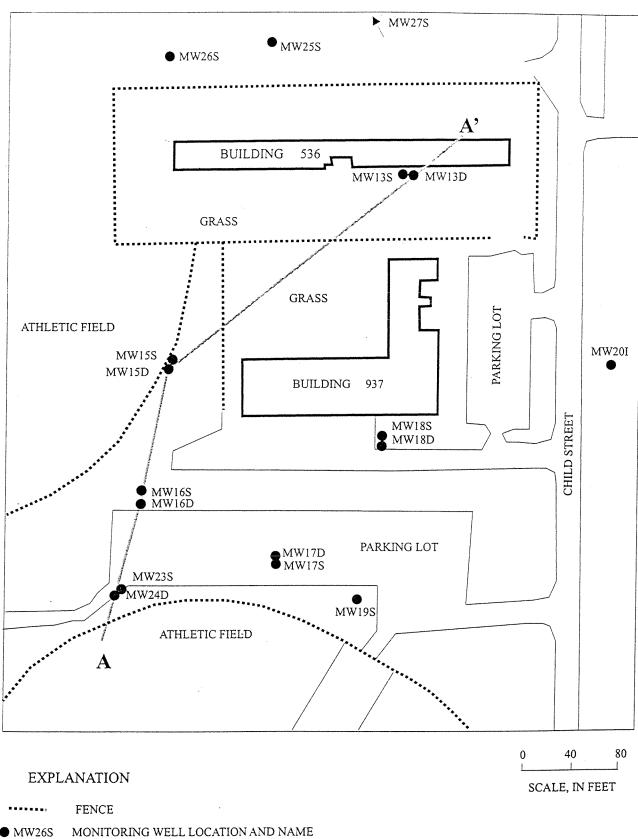
straight line segment is due to the aquifer hydraulic conductivity (Bower, 1979) and is the data fitted to the straight line. All of the wells in which the well screen intersected the water table showed this to some degree. The data from the confined wells showed a uniform slope from the first few seconds of the test until near the end. An example of this can be seen in the data form MS15D (figure 9).

The hydraulic conductivities were fairly uniform for the water table wells and ranged from 3 to 7 ft/day (figure 3). These values fall within the ranged of expected values for the station compared to three 24-hour multiple well aquifer tests previously performed at the station. The first was conducted in a silty sand that produced a hydraulic conductivity of 5.0 ft/day (Davis, 1995); the second was conducted in a relatively clean fine sand that produced a hydraulic conductivity of 20 ft/day (Davis, 1996a); and the third was conducted in a fine sand with silt and clay that produced a hydraulic conductivity of 0.6 ft/day (Davis, 1996b).

The hydraulic conductivities for the confined wells computed for these tests ranged from 0.3 ft/day to 7 ft/day (figure 4). Based on the above discussion, these are within the range of values expected at the Air Station. The confined wells had the greatest range of conductivities computed at the site, indicating that the lithology may be more variable in the deeper part of the surficial aquifer than in the shallower part.

REFERENCES

- Bouwer, H. and Rice, R.C., 1976, A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells: Water Resources Research, Vol. 12, No. 3, p. 423-428
- Bouwer, H., 1988, The Bouwer and Rice slug test an update: Ground Water, Vol. 27, No. 3, p. 304-309
- Davis, J. H., 1995, Documentation of aquifer test conducted near Operable Unit 1 at the U.S. Naval Air Station, Jacksonville, Florida, U.S. Geological Survey Open-File Report, 25 p.
- ----, J. H., 1996a, Documentation of aquifer test conducted at Area D, Operable Unit 3, U.S. Naval Air Station, Jacksonville, Florida, U.S. Geological Survey Open-File Report, 30 p.
- ----, J. H., 1996b, Documentation of aquifer test conducted at Area A, Operable Unit 3, U.S. Naval Air Station, Jacksonville, Florida, U.S. Geological Survey Open-File Report, 15 p.
- Halford, K.J. and Kuniansky, E. L., Documentation of spreadsheets for the analysis of aquifer-test and slug-test data: U. S. Geological Survey Open-File Report 02-197, 50 p.



MW26S MONITORING WELL LOCATION AND NAME

Figure 1. Location of wells used for slug testing at PSC 47.

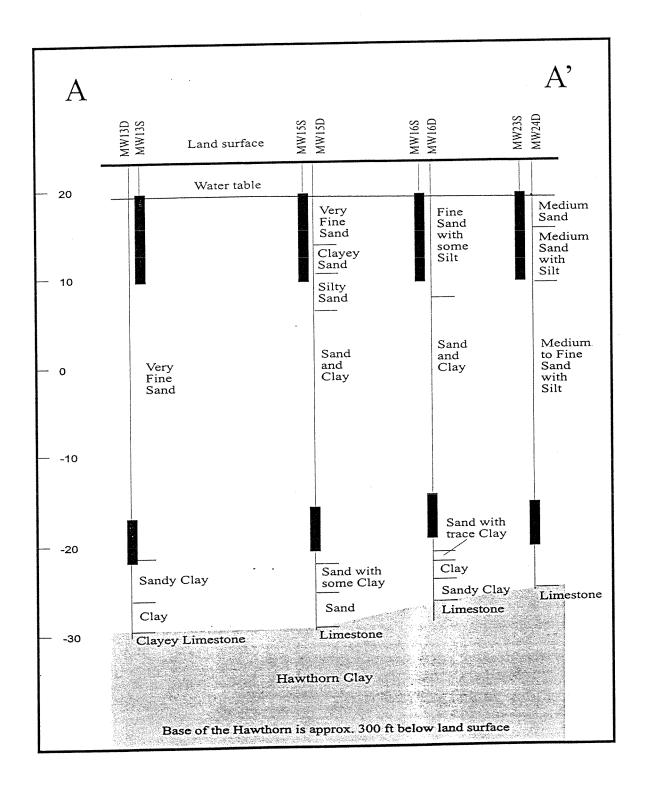


Figure 2. Geologic cross section at PSC 47.

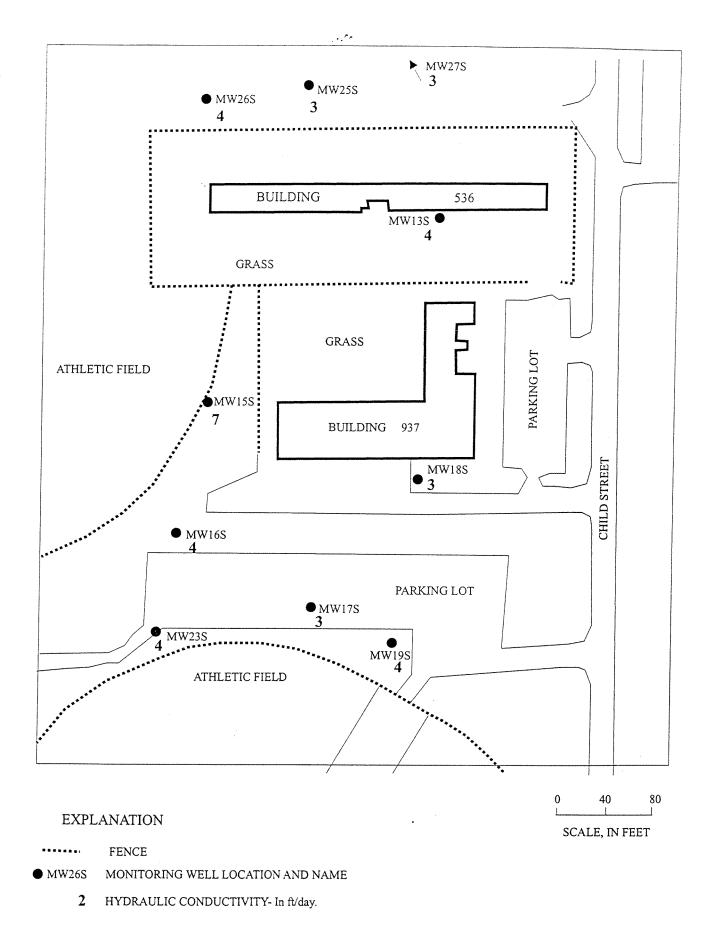


Figure 3. Hydraulic conductivities in the water table wells.

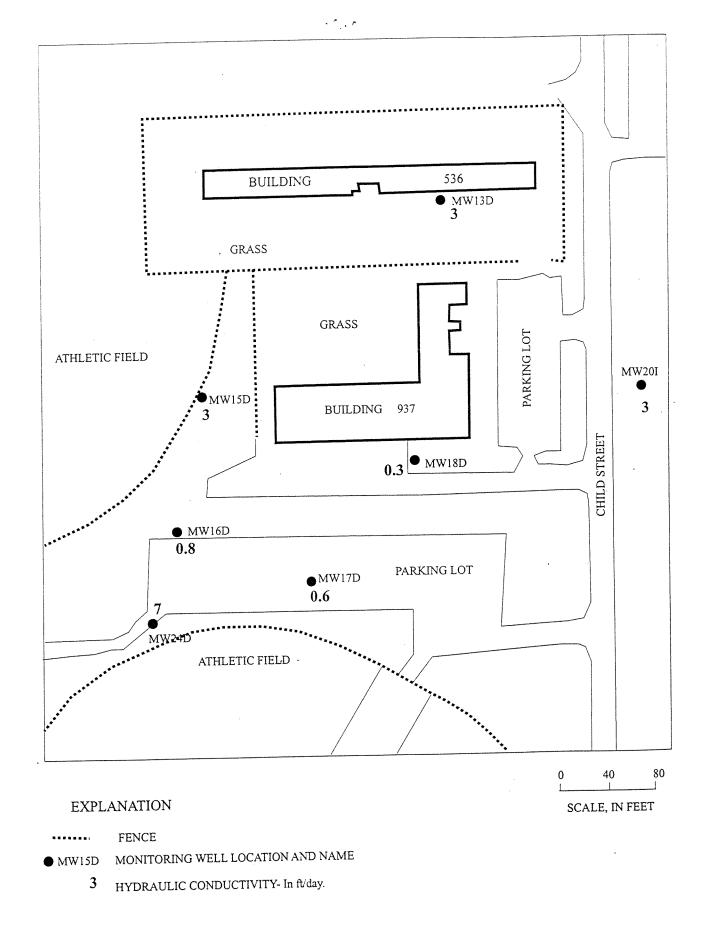
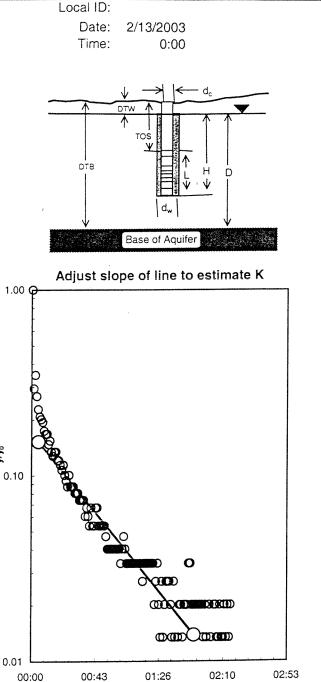


Figure 4. Hydraulic conductivities in the confined wells.

WELL ID: MS-13S

INPUT Construction: Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch 10 Feet Screen Length (L) Depths to: water level (DTW) 4.82 Feet top of screen (TOS) 2.5 Feet 12.5 Feet Base of Aquifer (DTB) Annular Fill: across screen -- Medium Sand above screen -- Backfill Aquifer Material -- Surficial Aquifer, centré COMPUTED 7.68 Feet -wetted D= 7.68 Feet 7.68 Feet $L/r_w =$ 22.34 1.49 Feet Yo-DISPLACEMENT = 1.27 Feet Yo-slug = From look-up table using L/r_w Fully penetrate C = 1.817 ln(Re/rw) =2.296 3.42 Feet Re = Slope = $0.009877 \log_{10}/\text{sec}$ t_{90%} recovery = 101 sec Input is consistent.



K = 2 Feet/Day

REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

TIME, Minute: Second

Local ID: Date: 2/13/2003 **INPUT** 0:00 Time: Construction: Casing dia. (d_c) 2 Inch 8.25 Inch Annulus dia. (dw) 10 Feet Screen Length (L) Depths to: water level (DTW) 4.82 Feet DTB 2.5 Feet top of screen (TOS) Base of Aquifer (DTB) 12.5 Feet Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 **G** Aquifer Material -- Surficial Aquifer, centre COMPUTED 7.68 Feet Lwetted 7.68 Feet D =7.68 Feet H = 22.34 $L/r_w =$ 1.09 Feet Y_{0-DISPLACEMENT} = 1.27 Feet Yo-SLUG = From look-up table using L/r_w 0.10 1.817 Fully penetrate C = 2.296 ln(Re/rw) =3.42 Feet **(1230)** O Re = Slope = $0.011145 \log_{10}/\text{sec}$ CORRESPO 90 sec t_{90%} recovery = Input is consistent. 2 Feet/Day 0.01 K = 02:53 01:26 02:10 00:43 00:00 TIME, Minute: Second Bouwer and Rice analysis of slug test, WRR 1976 **REMARKS:** Rising head test.

Figure 6. Results of rising-head slug test for well MW13S.

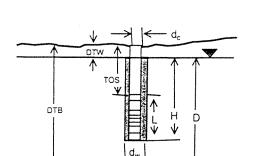
WELL ID: MS-13D

INPUT Construction: Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch Screen Length (L) 5 Feet Depths to: water level (DTW) 2.64 Feet top of screen (TOS) 37 Feet 42 Feet Base of Aquifer (DTB) Annular Fill: across screen -- Medium Sand above screen -- Bentonite Aquifer Material -- Surficial Aquifer, centré COMPUTED 5 Feet Lwetted D = 39.36 Feet H = 39.36 Feet

 $L/r_w =$ 14.55 1.06 Feet Yo-DISPLACEMENT = 1.27 Feet Yo-slug = From look-up table using L/rw

Fully penetrate C = 1.488 ln(Re/rw) =2.991 Re = 6.84 Feet Slope = $0.006049 \log_{10}/\text{sec}$ t_{90%} recovery = 165 sec Input is consistent.

1,4	0 - 1/0
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/\ 	Z I CCV Dav



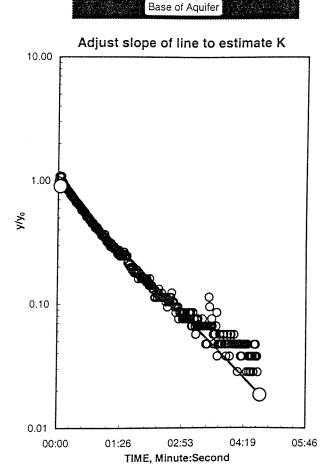
2/11/2003

0:00

Local ID:

Date:

Time:



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Figure 7. Results of falling-head slug test for well MW13D.

INPUT

Construction:		
Casing dia. (d _c)	2 Inch	
Annulus dia. (d _w)	8.25 Inch	
Screen Length (L)	5 Feet	
Depths to:		
water level (DTW)	2.64 Feet	
top of screen (TOS)	37 Feet	
Base of Aquifer (DTB)	42 Feet	
Annular Fill:		
across screen		
above screen	Bentonite	
Aquifer Material Surficial Aquifer, centre		

COMPUTED

L _{wetted}	5 Feet
D =	39.36 Feet
H =	39.36 Feet
L∕r _w =	14.55
Yo-DISPLACEMENT =	1.39 Feet
y _{0-slug} =	1.27 Feet
From look-up table using	g L/r _w

Fully penetrate C = 1.488 ln(Re/rw) = 2.991Re = 6.84 Feet

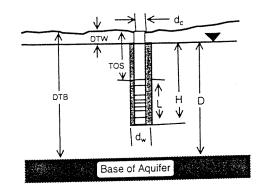
> Slope = $0.006262 \log_{10}/\text{sec}$ $t_{90\%}$ recovery = 160 sec

Input is consistent.

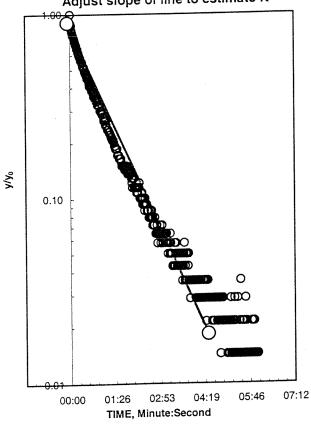
K = 3 Feet/Day

Local ID:

Date: 2/11/2003 Time: 0:00



Adjust slope of line to estimate K



Bouwer and Rice analysis of slug test, WRR 1976

Rising head test.

REMARKS:

Figure 8. Results of rising-head slug test for well MW13D.

WELL ID: MS-15S

Local ID:

INPUT Date: 2/13/2003 Time: 0:00 Construction: Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch Screen Length (L) 10 Feet Depths to: water level (DTW) 4.04 Feet DTB 3 Feet top of screen (TOS) 13 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 G Aquifer Material -- Surficial Aquifer, centre COMPUTED 8.96 Feet Lwetted D = 8.96 Feet 8.96 Feet H= $L/r_w =$ 26.07 1.37 Feet Yo-DISPLACEMENT = 1.47 Feet $y_{0-SLUG} =$ From look-up table using L/r_w 0.10 1.944 Fully penetrate C = 0 2.428 ln(Re/rw) =3.89 Feet Re = Slope = $0.008521 \log_{10}/\text{sec}$ O t_{90%} recovery = 117 sec Input is consistent. 2 Feet/Day K = 0.01 05:46 02:53 04:19 00:00 01:26 TIME, Minute:Second

	vc.
REMAR	n.5

Bouwer and Rice analysis of slug test, WRR 1976

Figure 9. Results of falling-head slug test for well MW15S.

WELL ID: MS-15S

Local ID:

Date: 2/13/2003 **INPUT** Time: 0:00 Construction: 2 Inch Casing dia. (d_c) 8.25 Inch Annulus dia. (dw) Screen Length (L) 10 Feet Depths to: 4.04 Feet water level (DTW) DTB 3 Feet top of screen (TOS) 13 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 G Aquifer Material -- Surficial Aquifer, centre COMPUTED 8.96 Feet Lwetted 8.96 Feet D =8.96 Feet H = $L/r_w =$ 26.07 1.47 Feet Yo-DISPLACEMENT = 1.47 Feet $y_{0-SLUG} =$ y/y From look-up table using L/r_w 0.10 Fully penetrate C = 1.944 In(Re/rw) = 2.428 3.89 Feet Re = [nemated at the following] Slope = $0.012507 \log_{10}/\text{sec}$ 00000 80 sec t_{90%} recovery = Input is consistent. ന്തെ ത 2 Feet/Day K = 0.01 02:10

REMARKS:	Bouwer and Rice analysis of slug test, WRR 1976
Rising head test.	

00:00

00:43

TIME, Minute:Second

01:26

Figure 10. Results of rising-head slug test for well MW15S.

Local ID: **INPUT** Date: 2/12/2003 Time: 0:00 Construction: Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch 5 Feet Screen Length (L) Depths to: water level (DTW) 5.76 Feet DTB top of screen (TOS) 39 Feet 44 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Bentonite Adjust slope of line to estimate K 1.00 @ Aquifer Material -- Surficial Aquifer, centre COMPUTED 5 Feet D= 38.24 Feet 38.24 Feet H = $L/r_w =$ 14.55 1.51 Feet Yo-DISPLACEMENT = 1.27 Feet Yo-slug = From look-up table using L/r_w 0.10 Fully penetrate C = 1.488 ln(Re/rw) =2.979 Re = 6.76 Feet ∞ 0.007419 log₁₀/sec Slope = 0 t_{90%} recovery = 135 sec. Input is consistent. 0 3 Feet/Day K = 0.01 02:10 02:53 03:36 04:19 00:00 00:43 01:26 TIME, Minute:Second Bouwer and Rice analysis of slug test, WRR 1976 **REMARKS:** Falling head test.

Figure 11. Results of falling-head slug test for well MW15D.

WELL ID: MS-15D

IN	Pl	JΤ
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Construction:	
Casing dia. (d _c)	2 Inch
Annulus dia. (d _w)	8.25 Inch
Screen Length (L)	5 Feet
Depths to:	
water level (DTW)	5.76 Feet
top of screen (TOS)	39 Feet
Base of Aquifer (DTB)	44 Feet
Annular Fill:	
across screen	Medium Sand
above screen	Bentonite
Aguifer Material	Surficial Aquifer, centra

COMPUTED

L _{wetted}	5 Feet	
D =	38.24 Feet	
H =	38.24 Feet	
L/r _w =	14.55	
Yo-DISPLACEMENT =	1.41 Feet	
y _{0-SLUG} =	1.27 Feet	
From look-up table using L	/r _w	

Fully penetrate C = 1.488ln(Re/rw) = 2.979

Re = 6.76 Feet

Slope = $0.005724 \log_{10}/\text{sec}$

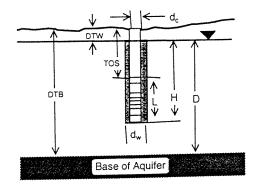
 $t_{90\%}$ recovery = 175 sec

Input is consistent.

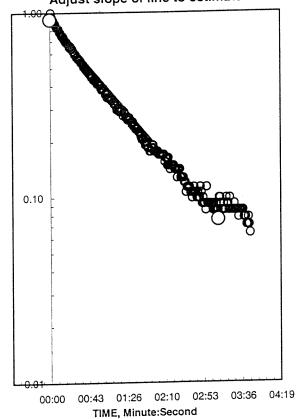
K = 2 Feet/Day

Local ID:

Date: 2/12/2003 Time: 0:00



Adjust slope of line to estimate K



Bouwer and Rice analysis of slug test, WRR 1976

REMARKS:

Rising head test.

Local ID: **INPUT** Date: 2/13/2003 Time: 0:00 Construction: Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch 10 Feet Screen Length (L) Depths to: 3.23 Feet water level (DTW) DTB top of screen (TOS) 3 Feet Base of Aquifer (DTB) 13 Feet Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Bentonite Adjust slope of line to estimate K 1.00 **@** Aquifer Material -- Surficial Aquifer, centré COMPUTED 9.77 Feet Lwetted D =9.77 Feet H = 9.77 Feet $L/r_w =$ 28.42 1.25 Feet Yo-DISPLACEMENT = 1.27 Feet Yo-slug = From look-up table using L/r_w 0.10 Fully penetrate C = 2.015 2.503 ln(Re/rw) =Re = 4.20 Feet \mathbf{o} Slope = $0.008993 \log_{10}/\text{sec}$ t_{90%} recovery = 111 sec. Input is consistent. 2 Feet/Day K = 0.01 02:53 02:10 00:43 01:26 00:00 TIME, Minute:Second

REMARKS

Bouwer and Rice analysis of slug test, WRR 1976

Figure 13. Results of falling-head slug test for well MW16S.

WELL ID: MS-16S

Local ID:

2/13/2003 Date: **INPUT** 0:00 Time: Construction: Casing dia. (d_c) 2 Inch 8.25 Inch Annulus dia. (dw) 10 Feet Screen Length (L) Depths to: 3.23 Feet water level (DTW) **DTB** 3 Feet top of screen (TOS) Base of Aquifer (DTB) 13 Feet Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Bentonite Adjust slope of line to estimate K 1.00 0 Aquifer Material -- Surficial Aquifer, centre COMPUTED 9.77 Feet Lwetted 9.77 Feet D =9.77 Feet H = 28.42 $L/r_w =$ 1.14 Feet Yo-DISPLACEMENT = 1.27 Feet у/у Yo-slug = From look-up table using L/r_w Fully penetrate C = 2.015 2.503 ln(Re/rw) = ∞ ∞ 4.20 Feet Re = Slope = $0.008996 \log_{10}/\text{sec}$ 111 sec t_{90%} recovery = Input is consistent.

REMARKS:	Bouwer and Rice analysis of slug test, WRR 197	
Rising head test.		

0.01

00:00

Figure 14. Results of rising-head slug test for well MW16S.

2 Feet/Day

K =

02:10

01:26

00:43

TIME, Minute: Second

WELL ID: MS-16D

	INPUT	
Construction:		***************************************
Casing dia.	(d _c) 2	Inch
Annulus dia. ((d _w) 8.25	Inch
Screen Length	(L) 5	Feet
Depths to:		
water level (DT	W) 3.7	Feet
top of screen (TO	OS) 36.5	Feet
Base of Aquifer (D	ΓB) 41.5	Feet
Annular Fill:		
across scree	n Medium Sa	ınd
above screer	n Bentonite	
Aquifer Materia	I Surficial Aq	uifer, centré
	COMPUTE	D
L _{we}	tted 5	Feet

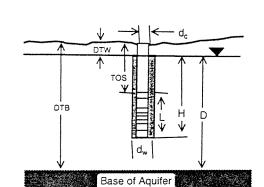
CON	COMPUTED							
L _{wetted}	5 Feet							
D =	37.8 Feet							
_ H =	37.8 Feet							
$L/r_w =$	14.55							
Yo-displacement =	1.25 Feet							
Yo-slug =	1.27 Feet							
From look-up table using L	/r _w							

Fully penetrate C = 1.488 ln(Re/rw) = 2.973 Re = 6.72 Feet

Slope = 0.002043 log_{10}/sec $t_{90\%}$ recovery = 489 sec

Input is consistent.

K	=	8.0	Feet/Day

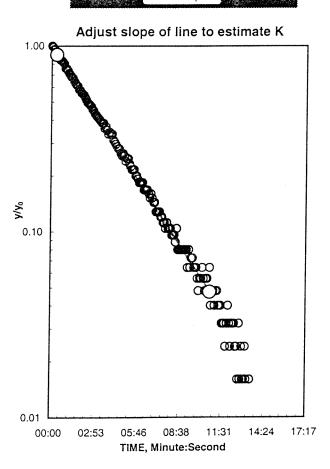


2/11/2003

0:00

Local ID: Date:

Time:



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Figure 15. Results of falling-head slug test for well MW16D.

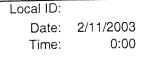
WELL ID: MS-16D

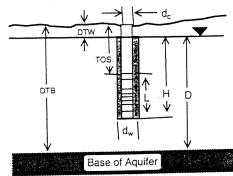
INPUT Construction: 2 Inch Casing dia. (d_c) Annulus dia. (dw) 8.25 Inch 5 Feet Screen Length (L) Depths to: water level (DTW) 3.7 Feet 36.5 Feet top of screen (TOS) 41.5 Feet Base of Aquifer (DTB) Annular Fill: across screen -- Medium Sand above screen -- Bentonite 1.00 @ Aquifer Material -- Surficial Aquifer, centre COMPUTED 5 Feet Lwetted 37.8 Feet D =37.8 Feet H =14.55 $L/r_w =$ 1.35 Feet

 $y_{0\text{-DISPLACEMENT}} = 1.35 \text{ Feet}$ $y_{0\text{-SLUG}} = 1.27 \text{ Feet}$ From look-up table using L/r_w

Fully penetrate C = 1.488 ln(Re/rw) = 2.973 Re = 6.72 FeetSlope = 0.001857 log_{10}/sec $t_{90\%}$ recovery = 538 sec

	K =	0.8	Feet/Day
1			





0.10
October 1.00

REMARKS:

Input is consistent.

Bouwer and Rice analysis of slug test, WRR 1976

Rising head test.

WELL ID: MS-17S

Local ID:

INPUT 2/13/2003 Date: Time: Construction: 0:00 Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch 10 Feet Screen Length (L) Depths to: water level (DTW) 2.08 Feet DTB 2.5 Feet top of screen (TOS) 12.5 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 @ Aquifer Material -- Surficial Aquifer, centre COMPUTED 10 Feet Lwetted D = 10.42 Feet H = 10.42 Feet $L/r_w =$ 29.09 1.35 Feet Y₀-DISPLACEMENT = 1.27 Feet Yo-slug = From look-up table using L/r_w 0.10 2.041 Fully penetrate C = ln(Re/rw) =2.547 Re = 4.39 Feet \circ Slope = $0.007674 \log_{10}/\text{sec}$ t_{90%} recovery = 130 sec Input is consistent. 1 Feet/Day K = 0.01 04:19 05:46 00:00 01:26 02:53 TIME, Minute: Second

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R	Ε	M	Α	R	KS	:

Bouwer and Rice analysis of slug test, WRR 1976

Falling head tes	2†		
aming nead tes	J.,		

Figure 17. Results of falling-head slug test for well MW17S.

Local ID: 2/13/2003 Date: **INPUT** 0:00 Time: Construction: 2 Inch Casing dia. (d_c) 8.25 Inch Annulus dia. (dw) 10 Feet Screen Length (L) Depths to: 2.08 Feet water level (DTW) DTB 2.5 Feet top of screen (TOS) 12.5 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 G Aquifer Material -- Surficial Aquifer, centre COMPUTED 10 Feet Lwetted 10.42 Feet D =H = 10.42 Feet 29.09 $L/r_w =$ 1.22 Feet Yo-DISPLACEMENT = 1.27 Feet Yo-slug = From look-up table using L/r_w 0.10 2.041 Fully penetrate C = 2.547 ln(Re/rw) =4.39 Feet Re = OCD CHARGE Slope = $0.014361 \log_{10}/\text{sec}$ 70 sec t_{90%} recovery = 0 000 0Input is consistent. 3 Feet/Day K = 0.01 02:10 02:53 01:26 00:43 00:00 TIME, Minute:Second Bouwer and Rice analysis of slug test, WRR 1976 REMARKS: Rising head test.

Figure 18. Results of rising-head slug test for well MW17S.

Local ID: **INPUT** 2/11/2003 Date: Time: 0:00 Construction: Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch Screen Length (L) 5 Feet Depths to: water level (DTW) 2.64 Feet DTB top of screen (TOS) 37 Feet Base of Aquifer (DTB) 42 Feet Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Bentonite Adjust slope of line to estimate K 1.00 Aquifer Material -- Surficial Aquifer, centré COMPUTED 5 Feet Lwetted 39.36 Feet D =H = 39.36 Feet $L/r_w =$ 14.55 1.25 Feet Yo-DISPLACEMENT = 1.27 Feet $y_{0-SLUG} =$ From look-up table using L/r_w 0.10 1.488 Fully penetrate C = 2.991 In(Re/rw) = 6.84 Feet Re = 0.001423 log₁₀/sec Slope = t_{90%} recovery = 702 sec Input is consistent. K = 0.6 Feet/Day 0.01 28:48 21:36 00:00 07:12 14:24 TIME, Minute:Second Bouwer and Rice analysis of slug test, WRR 1976 **REMARKS:** Falling head test.

Figure 19. Results of falling-head slug test for well MW17D.

INPUT Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch 5 Feet Screen Length (L) 2.64 Feet water level (DTW) 37 Feet top of screen (TOS) 42 Feet Base of Aquifer (DTB)

Annular Fill:

Construction:

Depths to:

across screen -- Medium Sand above screen -- Bentonite

Aquifer Material -- Surficial Aquifer, centre

COMPUTED

5 Feet Lwetted 39.36 Feet D =39.36 Feet H = 14.55 $L/r_w =$

1.33 Feet Y₀-DISPLACEMENT =

> 1.27 Feet Yo-slug =

From look-up table using L/r_w

Fully penetrate C = 1.488 2.991 In(Re/rw) =

6.84 Feet Re =

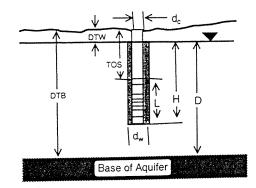
Slope = $0.001234 \log_{10}/\text{sec}$ 811 sec

t_{90%} recovery = Input is consistent.

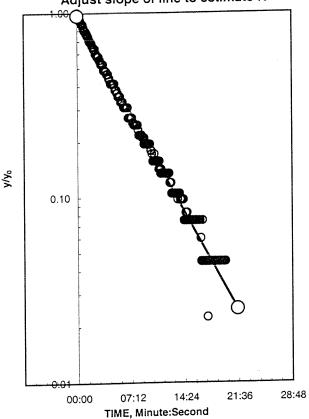
> 0.5 Feet/Day K =



2/11/2003 Date: 0:00 Time:



Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Rising head test.

Local ID: **INPUT** Date: 2/13/2003 Time: 0:00 Construction: Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch 10 Feet Screen Length (L) Depths to: water level (DTW) 4.16 Feet DTB 4 Feet top of screen (TOS) 14 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 Q Aquifer Material -- Surficial Aquifer, centré COMPUTED 9.84 Feet Lwetted 9.84 Feet D =9.84 Feet H =28.63 $L/r_w =$ 1.12 Feet Yo-DISPLACEMENT = 1.27 Feet $y_{0-SLUG} =$ From look-up table using L/r_w 0.10 Fully penetrate C = 2.021 2.509 ln(Re/rw) =4.23 Feet Re = 0 0.015635 log₁₀/sec Slope = t_{90%} recovery = 64 sec 00 00 Input is consistent. K = 3 Feet/Day 0.01 01:26 01:44 00:35 00:52 01:09 00:00 00:17 TIME, Minute: Second Bouwer and Rice analysis of slug test, WRR 1976 **REMARKS:** Falling head test.

Figure 21. Results of falling-head slug test for well MW18S.

WELL ID: MS-18S

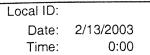
INPUT Construction: 2 Inch Casing dia. (d_c) Annulus dia. (dw) 8.25 Inch 10 Feet Screen Length (L) Depths to: water level (DTW) 4.16 Feet 4 Feet top of screen (TOS) 14 Feet Base of Aquifer (DTB) Annular Fill: across screen -- Medium Sand above screen -- Backfill Aquifer Material -- Surficial Aquifer, centre COMPUTED 9.84 Feet Lwetted 9.84 Feet D =

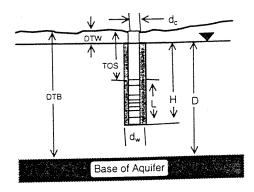
Fully penetrate C = 2.021 ln(Re/rw) = 2.509 Re = 4.23 Feet $Slope = 0.013441 log_{10}/sec$

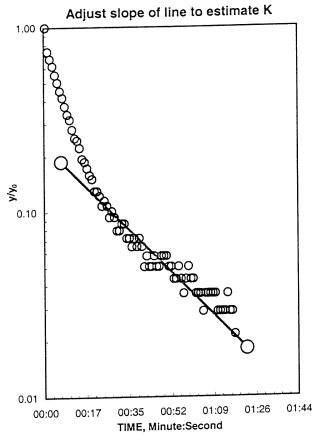
 $t_{90\%} \text{ recovery} = 74 \text{ sec}$

Input is consistent.

K =	2 Feet/Day







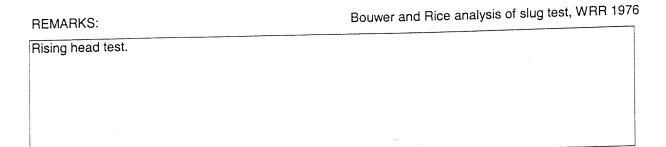


Figure 22. Results of rising-head slug test for well MW18S.

Local ID: **INPUT** Date: 2/12/2003 Construction: Time: 0:00 Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch Screen Length (L) 5 Feet Depths to: water level (DTW) 4.63 Feet DTB top of screen (TOS) 39 Feet 44 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Bentonite Adjust slope of line to estimate K 1.00 Aquifer Material -- Surficial Aquifer, centré COMPUTED 5 Feet Lwetted D =39.37 Feet H = 39.37 Feet $L/r_w =$ 14.55 1.31 Feet Yo-DISPLACEMENT = 1.27 Feet $y_{0-SLUG} =$ From look-up table using L/r_w 0.10 Fully penetrate C = 1.488 2.991 ln(Re/rw) =Re = 6.84 Feet Slope = $0.000776 \log_{10}/\text{sec}$ t_{90%} recovery = 1288 sec Input is consistent. 0.3 Feet/Day K = 0.01 11:31 14:24 00:00 02:53 05:46 08:38

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Bouwer and Rice analysis of slug test, WRR 1976

TIME, Minute: Second

Figure 23. Results of falling-head slug test for well MW18D.

Local ID: 2/12/2003 **INPUT** Date: Time: 0:00 Construction: 2 Inch Casing dia. (d_c) 8.25 Inch Annulus dia. (dw) 5 Feet Screen Length (L) Depths to: 4.63 Feet water level (DTW) DTB 39 Feet top of screen (TOS) 44 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Bentonite Adjust slope of line to estimate K 1.00(Aquifer Material -- Surficial Aquifer, centre COMPUTED 5 Feet Lwetted 39.37 Feet D =39.37 Feet H =14.55 $L/r_w =$ 1.38 Feet Y₀-DISPLACEMENT = 1.27 Feet Yo-SLUG = From look-up table using L/r_w 0.10 1.488 Fully penetrate C = 2.991 In(Re/rw) = 6.84 Feet Re = Slope = $0.000679 \log_{10}/\text{sec}$ 1474 sec t_{90%} recovery = Input is consistent. 0.3 Feet/Day K = 0.01 14:24 11:31 05:46 08:38 02:53 00:00 TIME, Minute: Second Bouwer and Rice analysis of slug test, WRR 1976 REMARKS: Rising head test.

Figure 24. Results of rising-head slug test for well MW18D.

WELL ID: MS-19S

Local ID: **INPUT** Date: 2/13/2003 Time: Construction: 0:00 Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch Screen Length (L) 10 Feet Depths to: water level (DTW) 1.83 Feet отв top of screen (TOS) 2.5 Feet Base of Aquifer (DTB) 12.5 Feet Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 Aquifer Material -- Surficial Aquifer, centre COMPUTED 10 Feet Lwetted 10.67 Feet D =H =10.67 Feet $L/r_w =$ 29.09 1.26 Feet Yo-DISPLACEMENT = 1.27 Feet Yo-slug = χ̈́ From look-up table using L/r_w 0.10 Fully penetrate C = 2.041 2.562 ln(Re/rw) =4.45 Feet Re = Slope = $0.006231 \log_{10}/\text{sec}$ t_{90%} recovery = 160 sec Input is consistent. 1 Feet/Day K = 0.01 05:46 04:19 00:00 01:26 02:53 TIME, Minute: Second

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Bouwer and Rice analysis of slug test, WRR 1976

Figure 25. Results of falling-head slug test for well MW19S.

INPUT

Construction:	
Casing dia. (d _c)	2 Inch
Annulus dia. (d _w)	8.25 Inch
Screen Length (L)	10 Feet
Depths to:	
water level (DTW)	1.83 Feet
top of screen (TOS)	2.5 Feet
Base of Aquifer (DTB)	12.5 Feet
Annular Fill:	
across screen	
above screen	Backfill
Aquifer Material	Surficial Aquifer, centra

COMPUTED

<u> </u>	J
L _{wetted}	10 Feet
D =	10.67 Feet
H =	10.67 Feet
L/r _w =	29.09
Y ₀ -DISPLACEMENT =	0.88 Feet
y _{0-slug} =	1.27 Feet
From look-up table using	ı L∕r _w

Fully penetrate C = 2.041 ln(Re/rw) = 2.562Re = 4.45 Feet

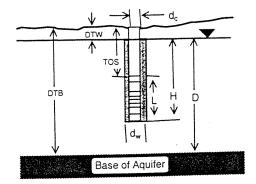
> Slope = $0.010916 \log_{10}/\text{sec}$ $t_{90\%}$ recovery = 92 sec

Slug discrepancy of 36% is greater thanmaximum of 20%

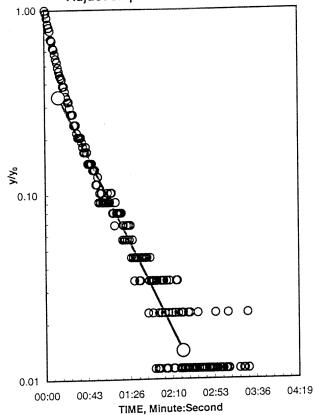
K = Error Feet/Day

Local ID:

Date: 2/13/2003 Time: 0:00



Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Rising head test.

Local ID: **INPUT** Date: 2/12/2003 Time: Construction: 0:00 Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch Screen Length (L) 5 Feet Depths to: water level (DTW) 2.83 Feet DTB top of screen (TOS) 20 Feet 25 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Bentonite Adjust slope of line to estimate K 1.00 Aquifer Material -- Surficial Aquifer, centré COMPUTED 5 Feet Lwetted 22.17 Feet D =H =22.17 Feet $L/r_w =$ 14.55 1.13 Feet Yo-DISPLACEMENT = 1.27 Feet Yo-slug = у/у From look-up table using L/r_w 0.10 Fully penetrate C = 1.488 2.730 ln(Re/rw) =0 Re = 5.27 Feet DOI: (DC Slope = 0.006289 log₁₀/sec 159 sec t_{90%} recovery = Input is consistent. K = 2 Feet/Day 0.01 05:46 07:12 00:00 01:26 02:53 04:19 TIME, Minute:Second Bouwer and Rice analysis of slug test, WRR 1976 REMARKS:

Figure 27. Results of falling-head slug test for well MW20I.

Local ID: 2/12/2003 Date: **INPUT** 0:00 Time: Construction: Casing dia. (d_c) 2 Inch 8.25 Inch Annulus dia. (dw) 5 Feet Screen Length (L) Depths to: 2.83 Feet water level (DTW) DTB 20 Feet top of screen (TOS) 25 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Bentonite Adjust slope of line to estimate K 1.00 Aquifer Material -- Surficial Aquifer, centre COMPUTED 5 Feet 22.17 Feet D =22.17 Feet H = 14.55 $L/r_w =$ 1.36 Feet Y₀-DISPLACEMENT = 1.27 Feet y_{0-SLUG} = From look-up table using L/r_w 0.10 1.488 Fully penetrate C = 2.730 ln(Re/rw) =5.27 Feet Re = Slope = $0.007376 \log_{10}/\text{sec}$ t_{90%} recovery = 136 sec Input is consistent. 3 Feet/Day K = 0.01 05:46 04:19 02:53 01:26 00:00 TIME, Minute:Second

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Bouwer and Rice analysis of slug test, WRR 1976

Rising head test.		

Figure 28. Results of rising-head slug test for well MW20I.

WELL ID: MS-23

Local ID: **INPUT** Date: 2/13/2003 Time: 0:00 Construction: Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch 10 Feet Screen Length (L) Depths to: 3.67 Feet water level (DTW) DTB 5 Feet top of screen (TOS) Base of Aquifer (DTB) 15 Feet Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 G Aquifer Material -- Surficial Aquifer, centre COMPUTED 10 Feet Lwetted D =11.33 Feet H = 11.33 Feet $L/r_w =$ 29.09 1.49 Feet Yo-DISPLACEMENT = 1.27 Feet Yo-slug = γ̈́λ From look-up table using L/rw 0.10 2.041 Fully penetrate C = In(Re/rw) = 2.598 4.62 Feet Re = 0 0.021207 log₁₀/sec Slope = യായാ അവരാ t_{90%} recovery = 47 sec Input is consistent. \circ K = 4 Feet/Day 0.01 02:10 01:26 00:00 00:43 TIME, Minute:Second

REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Figure 29. Results of falling-head slug test for well MW23S.

Local ID: Date: 2/13/2003 **INPUT** 0:00 Time: Construction: 2 Inch Casing dia. (d_c) 8.25 Inch Annulus dia. (dw) 10 Feet Screen Length (L) Depths to: 3.67 Feet water level (DTW) DTB 5 Feet top of screen (TOS) 15 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 € Aquifer Material -- Surficial Aquifer, centre COMPUTED 10 Feet Lwetted 11.33 Feet D =11.33 Feet H = 29.09 $L/r_w =$ 0.97 Feet Yo-DISPLACEMENT = 1.27 Feet Yo-slug = From look-up table using L/r_w 0.10 Fully penetrate C = 2.041 2.598 ln(Re/rw) =4.62 Feet Re = DO minimida (O Slope = $0.022667 \log_{10}/\text{sec}$ 00 44 sec t_{90%} recovery = Slug discrepancy of 27% is greater thanmaximum of 20% Error Feet/Day 0.01 K = 01:44 00:52 01:09 01:26 00:35 00:00 00:17 TIME, Minute:Second

REMARKS:	Bouwer and Rice analysis of slug test, WRR 1976
Rising head test.	

Figure 30. Results of rising-head slug test for well MW23S.

INPUT Construction: Casing dia. (d_c) 2 Inch 8.25 Inch Annulus dia. (dw) Screen Length (L) 5 Feet Depths to: water level (DTW) 2.64 Feet top of screen (TOS) 37 Feet 42 Feet Base of Aquifer (DTB) Annular Fill: across screen -- Medium Sand above screen -- Bentonite Aquifer Material -- Fine Sand COMPUTED 5 Feet Lwetted 39.36 Feet D =39.36 Feet H = 14.55 $L/r_w =$ 1.18 Feet Y₀-DISPLACEMENT =

Fully penetrate C = 1.488 In(Re/rw) = 2.991 Re = 6.84 Feet $Slope = 0.017791 log_{10}/sec$ $t_{90\%} recovery = 56 sec$ Input is consistent.

Yo-slug =

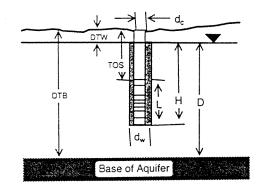
From look-up table using L/r_w

1.27 Feet

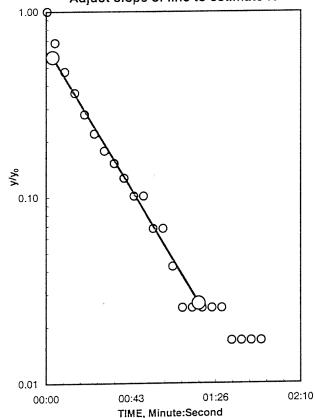
						_
Г	K =	7	F	eet	/Da	y
						Ξ.



Date: 2/11/2003 Time: 0:00



Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Falling head test.

INPUT Construction: Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch 5 Feet Screen Length (L) Depths to: 2.64 Feet water level (DTW) 37 Feet top of screen (TOS) 42 Feet Base of Aquifer (DTB) Annular Fill: across screen -- Medium Sand above screen -- Bentonite Aquifer Material -- Fine Sand COMPUTED 5 Feet 39.36 Feet D =39.36 Feet H =

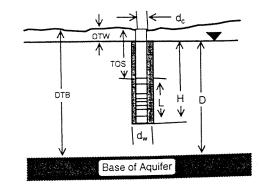
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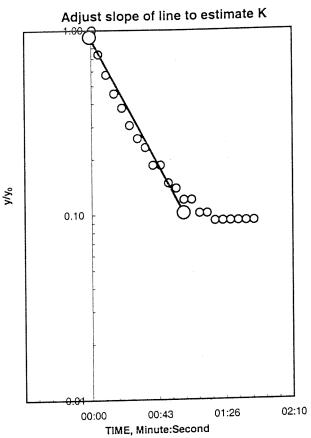
Fully penetrate C = 1.488 In(Re/rw) = 2.991 Re = 6.84 Feet $Slope = 0.01578 \log_{10}/\text{sec}$ $t_{90\%} \text{ recovery} = 63 \text{ sec}$ Input is consistent.

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Date: 2/11/2003 Time: 0:00





REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Rising head test.

Figure 32. Results of rising-head slug test for well MW24D.

Local ID: 2/13/2003 **INPUT** Date: Time: 0:00 Construction: Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch 10 Feet Screen Length (L) Depths to: water level (DTW) 4.82 Feet DTB 4 Feet top of screen (TOS) 14 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 G Aquifer Material -- Surficial Aquifer, centre COMPUTED 9.18 Feet Lwetted D =9.18 Feet H = 9.18 Feet $L/r_w =$ 26.71 1.08 Feet Yo-DISPLACEMENT = 1.27 Feet Yo-slug = From look-up table using L/r_w 0.10 Fully penetrate C = 1.964 2.449 ln(Re/rw) =3.98 Feet Re = O ∞ Slope = $0.014088 \log_{10}/\text{sec}$ 71 sec t_{90%} recovery = Input is consistent. 3 Feet/Day K = 0.01 03:36 00:43 01:26 02:10 02:53 00:00 TIME, Minute: Second Bouwer and Rice analysis of slug test, WRR 1976 **REMARKS:** Falling head test.

Figure 33. Results of falling-head slug test for well MW25S.

Local ID: 2/13/2003 Date: **INPUT** 0:00 Time: Construction: 2 Inch Casing dia. (d_c) 8.25 Inch Annulus dia. (dw) Screen Length (L) 10 Feet Depths to: 4.82 Feet water level (DTW) DTB 4 Feet top of screen (TOS) 14 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 € Aquifer Material -- Surficial Aquifer, centre COMPUTED 9.18 Feet L_{wetted} 9.18 Feet D =9.18 Feet H =26.71 $L/r_w =$ 1.29 Feet Y₀-DISPLACEMENT = 1.27 Feet $y_{0-SLUG} =$ From look-up table using L/r_w 0.10 Fully penetrate C = 1.964 2.449 0 In(Re/rw) = 00 3.98 Feet Re = 0.015171 log₁₀/sec Slope = t_{90%} recovery = Input is consistent. 3 Feet/Day K = 0.01 02:53 02:10 01:26 00:00 00:43 TIME, Minute:Second Bouwer and Rice analysis of slug test, WRR 1976 REMARKS: Rising head test.

Figure 34. Results of rising-head slug test for well MW25S.

Local ID: **INPUT** Date: 2/13/2003 Construction: Time: 0:00 Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch Screen Length (L) 10 Feet Depths to: water level (DTW) 4.77 Feet DTB top of screen (TOS) 3 Feet Base of Aquifer (DTB) 13 Feet Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 G Aquifer Material -- Surficial Aquifer, centré COMPUTED 8.23 Feet Lwetted D =8.23 Feet H= 8.23 Feet $L/r_w =$ 23.94 1.41 Feet Yo-DISPLACEMENT = 1.27 Feet Yo-slug = From look-up table using L/r_w Fully penetrate C = 1.874 2.355 ln(Re/rw) =Re = 3.62 Feet **@**0000 0.008373 log₁₀/sec Slope = t_{90%} recovery = 119 sec Input is consistent. K = 2 Feet/Day 0.01 00:00 00:43 01:26 02:10 TIME, Minute: Second Bouwer and Rice analysis of slug test, WRR 1976 **REMARKS:** Falling head test.

Figure 35. Results of falling-head slug test for well MW26S.

Local ID: 2/13/2003 Date: **INPUT** 0:00 Time: Construction: Casing dia. (d_c) 2 Inch 8.25 Inch Annulus dia. (dw) 10 Feet Screen Length (L) Depths to: 4.77 Feet water level (DTW) DTB 3 Feet top of screen (TOS) 13 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand danco co accomandado above screen -- Backfill Adjust slope of line to estimate K Aquifer Material -- Surficial Aquifer, centre COMPUTED 8.23 Feet 8.23 Feet D =H = 8.23 Feet 23.94 $L/r_w =$ 1.08 Feet Y₀-DISPLACEMENT = 1.27 Feet $y_{0-SLUG} =$ From look-up table using L/r_w 0.10 Fully penetrate C = 1.874 2.355 ln(Re/rw) =3.62 Feet Re = ∞ 0.006514 log₁₀/sec Slope = t_{90%} recovery = 154 sec 0 Input is consistent. 1 Feet/Day 0.01 K = 02:53 02:10 01:26 00:00 00:43 TIME, Minute: Second Bouwer and Rice analysis of slug test, WRR 1976 **REMARKS**: Rising head test.

Figure 36. Results of rising-head slug test for well MW26S.

Local ID:

INPUT Date: 2/13/2003 Time: Construction: 0:00 Casing dia. (d_c) 2 Inch Annulus dia. (dw) 8.25 Inch Screen Length (L) 10 Feet Depths to: water level (DTW) 5.25 Feet DTB top of screen (TOS) 3 Feet 13 Feet Base of Aquifer (DTB) Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 G Aquifer Material -- Surficial Aquifer, centre COMPUTED 7.75 Feet -wetted 7.75 Feet D =H = 7.75 Feet 22.55 $L/r_w =$ 1.32 Feet Yo-DISPLACEMENT = 1.27 Feet $y_{0-SLUG} =$ From look-up table using L/r_w 0.10 Fully penetrate C = 1.825 2.304 ln(Re/rw) =3.44 Feet Re = Slope = $0.009959 \log_{10}/\text{sec}$ $\mathbf{content}$ t_{90%} recovery = 100 sec Input is consistent. 2 Feet/Day K = 0.01 02:53 02:10 00:00 00:43 01:26 TIME, Minute: Second

REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Falling head test.

WELL ID: MS-27S

Local ID: 2/13/2003 Date: **INPUT** 0:00 Time: Construction: Casing dia. (d_c) 2 Inch 8.25 Inch Annulus dia. (dw) 10 Feet Screen Length (L) Depths to: 5.25 Feet water level (DTW) DTB 3 Feet top of screen (TOS) Base of Aquifer (DTB) 13 Feet Annular Fill: Base of Aquifer across screen -- Medium Sand above screen -- Backfill Adjust slope of line to estimate K 1.00 € Aquifer Material -- Surficial Aquifer, centre COMPUTED 7.75 Feet Lwetted 7.75 Feet D =7.75 Feet H = 22.55 $L/r_w =$ 1.30 Feet Y₀-DISPLACEMENT = 1.27 Feet $y_{0-SLUG} =$ ۸/<u>/</u> From look-up table using L/r_w 0.10 1.825 Fully penetrate C = 2.304 ln(Re/rw) =3.44 Feet Re = Slope = $0.015535 \log_{10}/\text{sec}$ 64 sec t_{90%} recovery = Input is consistent. 3 Feet/Day K = 0.01 01:26 00:52 01:09 00:35 00:17 00:00 TIME, Minute: Second

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Bouwer and Rice analysis of slug test, WRR 1976

Risnig head test.

Figure 38. Results of rising-head slug test for well MW27S.

APPENDIX A: LITHOLOGY LOGS

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					2021		oro, The 17	c012	S	
PROJECT		CTO	162 / Pestid	cide Shop	BORIN	IG NOM	BER: JAX-47- 3.19.02	<u>-30/3</u>	<u> </u>	
PROJECT DRILLING		: <u>N396</u>	ent/ATT	13 1100	DATE:	OGIST:	L. KNIGHT	7		
		Mal	BIL DRILL	8-57	DRILLI		LEWIS JOH	NSON		····
DRILLING	nia.	7.107							FID Readin	og (202)
Sample Depth No. (Fl.) and or Type or Run RQD No.	Blows / Sam 6" or Reco RQD / (%) Sam Leng	very Change (Depth/F ple) gth or Screene Interval	ny Soil a Soil a Consistent y C	ATERIAL DE	SCHIPTION rial Classification	U S C S ·	Remarks	Sample	Sampler 82	
		0.1	d	SAND	FILL V. brown	4 AV				
		1.0		SALL	Fill, y.bioun,), fine, V.fir	J /				
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Vhen rock coring, Include monitor re emarks:	enter rock bro eading in 6 foo	okeness. ot intervals G	borehole, Incre	ease reading freq	uency if elevated rep	oonse read.	D Backgro	rilling Are und (ppm	эа 1): <u>З</u>	9

Converted to Well:

Well I.D. #: 34x-47 - MW 135

Tt	Tetra	Tech	NUS,	inc.

Converted to Well:

BORING LOG

Page	of	-
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BORING NUMBER: JAX-47-SB13D
DATE: 3.19.02
GEOLOGIST: L. KNIGHT PROJECT NAME: CTO 162 / Pesticide Shop N3966+140050119 HYO C50 115 DATE: PROJECT NUMBER: DRILLING COMPANY: Ambient (ATI) LEWIS JOHNSON MOBIL DRILL 3-511 DRILLER: DRILLING RIG: PID/FID Reading (ppm) MATERIAL DESCRIPTION U Sample Lithology Depth Blows / Change Soil (Ft.) 6" or Recover S No. Density RQD (Depth/Pt Driller BZ** and С Consistent Sample Remarks Run Type o (%)) Color Material Classification y RQD Length or or Rock lemness STR BONNELOG FOR 5x-47-58135 Foi 15 41 45 48 50. EOB = 50'61 When rock coring, enter rock brokeness. **Drilling Area** "Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read. Background (ppm): 4.3 Remarks:

Well I.D. #: 3/2x-47 - MW/3P

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BORING-LOG BORING NUMBER: JAX-47-SB/55
DATE: 3.20.02
GEOLOGIST: // KNIGHT CTO 162 / Pesticide Shop PROJECT NAME: PROJECT NUMBER: N3966 HY0050119 HY0 050 115 DATE: DRILLING COMPANY: Ambient (ATT) LEWIS JOHNSON MOBILE DEAL 8-57 DRILLER: DRILLING RIG: PID/FID Reading (ppm) MATERIAL DESCRIPTION U Sample Lithology Blows / Sample Depth انحد S Change (Ft.) 6" or Recover No. Density/ (Depth/Ft. RQD С or and Remarks Consistent Sample (%) Run Type o Colo Material Classification y Length or ROD No. Screened Rock Interval Handness GHAST/ROOPS/SANDY TOPSOIL 05-SAND; fine, v. fine; It brown gray 2.5-JAND FINE; V. FINE; SUME CLAY L'SILT; YOL- GLOY, OR-BO 35. 9. 135-EOB = 13-5'bls When rock coring, enter rock brokeness. Drilling Area

" Include monitor reading in 6	toot interva	ils 0 borehole. In	rcrease reading frequency if el	evated reponse read.	Background (ppm): 2.7
Remarks:					Background (ppm).
					. 1/7 . MINIS
Converted to Well:	Yes		No	Well I.D. #: JA	x-47·MW/55

Tetra Tech NUS, Inc.

Page ___ of ___

BORING NUMBER: JAX-47-SE15D CTO 162 / Pesticide Shop PROJECT NAME: DATE: 3.2.02 GEOLOGIST: L. KNIGHT N3966+170050119 HYO CSO 15 DATE: PROJECT NUMBER: DRILLING COMPANY: Ambient (ATT)
DRILLING RIG: MUBIL DRILL B-57 LEWIS JOHNSON DRILLER: MATERIAL DESCRIPTION PID/FID Reading (ppm) U Sample Lithology Blows / Depth Sample S 6" or Change (Ft.) No. Density RQD (Depth/Pt. С Driller BZ* and Remarks Consisten Sample Run (%)) Type o S Material Classification Colo RQD or Rock Interval SEE SOL BOLINGLOG FORJX-47-5815S for 0-13.516s DESCRIPTION 135-SAND + CLAY in varying propadons predominanth sand; IRRESOLUTE, MUL rotary drilling, no split spapes in this interval. 42.5 SAND Wsome day SILIT SPOON 44.5 SPLIT SPOON 42.5 47.0 FOB = 47.5' bls

Remarks:

** Include monitor reading in 6 foot intervals © borehole. Increase reading frequency if elevated reponse read.

Drilling Area
Background (ppm): 4-7

On Mall Vos .

Well I.D. #: ゴスメ-47 - MW/5D

No

^{*} When rock coring, enter rock brokeness.

			001/0
PROJECT NAME:	CTO 162 / Pesticide Shop	BORING NUMB	BER: JAX-47-SB168
	N3966+140050119 HYO C50 113	-	3.20.02
DRILLING COMPANY:			L. KNIGHT
DRILLING COM ANT.	ALCON CALL S		CHUS TOHNSON

DHIL	LING	RIG:		MUD	L HILL	٠,	0	U) 116-6-11.		20,711				
					1	MATI	ERIAL DESC	RIPTION			PIC	O/FID R	eading	(ppm)
Sample No. and Type or RQD	(Ft.) or	Blows / 6" or RGD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Pt) or Screened Interval	Soil Density/ Consistent y	Colo		Classification	U S C S ·	Remarks	Батріе	Sampler 82	Barehole⁴⁴	Odiljer 82**
				0.3-			GRASS ROOTS	SANDY TOUSON, qu	1					
		$\overline{}$												
							SAND;	fine, V. fine; rown becoming						
							orange-b	rown becoming						
							pale yel-be	rown ab / and				ļ		
							ten 26 4	bls						
				8			<u>X</u>							
							7	//						
				}			SAND	H brown-						
	_			-			v. fine;	17 promu.						
	_						Yel hecom	ung orange-						
		$\langle \rangle$		13-5			brown at	11.2.90						\dashv
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	_						[0B]	13.5'615	•	.				\dashv
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•	When	rock	coring,	enter	rock	brokeness.	
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 Include monitor reading in 6 foot interv 	als @ borehole.	Increase reading frequency if elevated reponse read.	
Remarks:	*		

Drilling Area
Background (ppm): 3.3

Converted to Well: Yes No Well I.D. #: JAX-47 - MW 165

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	G	letra	Tech N	IUS, In	C.		<u>BOR</u>	ING	<u>LOG</u>						Pag)E	_ 0	_
PRO	DJECT	NAM	IE:	сто	162 / Pe	sticio	de Shop		BORINO DATE: GEOLO	UN 6	MBE	R: JA	×-4	1-SB	16	\mathcal{D}		
	JECT			N396	6 11Y005	011	HYOC	50 11 9	DATE:			3.2	8.0	2				
DRII	LING	COM	IPANY:	Ambi	ent(A.7	I)			GEOLO	GIST	: <u>/</u>	. KA	JIGH	$ au_{-}$				
DRIL	LING	RIG:		MUBI	IL DRIL	11	?-57		DRILLE	R:	L	-W15	JOH	11/50	<u> </u>	·	·····	
						MAT	ERIAL DE	SCRIPT	ION						PID	/FID Re	ading	(pp
Sample No. and Type or RQD	(Pt.) or	Blows / 6* or RQD (%)	Sample Recovery / Sample Length	Change (Depth/F	s Soil i. Dessity/ Consistent y d or	Cok	oj Mate	erial Classii	fication	,	U S C S ·	Ren	narks		Sample	Sampler 82	Borehole**	
							SEE S	OIL BOX	UNG LA	5								
		$\overline{}$					FOLJA											! L
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	+	\mathcal{A}	— ,	135		<u> </u>	SANDY CLA LAY FY SA LYGULAIL G	7: 9100	gran; kan		5/0	on			-	+	+	
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			ck broken: 6 foot inte		orehole. Inc	crease	reading freque	ency if elev	ated repons	e read			D	rilling	Are	a		
emarks		·										Ba	ckgro	und (p	pm)	:2	.8	

Remarks: Converted to Well: No Yes

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PRO	JEC1	NAME	Ξ:	CTO 1	162 / Pes	ticid	e Shop	вс	RING N	MUI	BER: JAX-47-5 3·20, 02 L. KNIGHT	B17	<u>S</u>		
PRO	JECT	NUME	BER:	N3966	5+1Y0050	2119	HY005	0 119 DA	ATE:	CT.	3.20.02				
			PANY:	Ambie	ent (AT	7)		GE	RILLER:	51.	LEWIS JOHN:	SON			
DRIL	LING	RIG:		MOBI	L DLILL					T	Zewis James	7			
						ITAN	ERIAL DES	SCRIPTIC	N BBBBBBBB	U		PID	VFID Re	ading (ppm)
Sample No.	Depth (Ft.)	Blows / 6" or	Sample Recovery	I	Soil					S					
and	or	ROD	/ Sample	(Depth/Pt.	Density/ Consistenc					С	Remarks	9,6	ar B.	Borehole**	BZ.
Type or RQD	Run No.	(%)	Length	or	9	Colo	Mater	ial Classifica	tion	S		Sample	ā	sreh	IIIer
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When ro	ock cori	ng, enter r	ock broke	eness.		_		uency if eleva	ted renone	a raad	Dri	lling A	rea		

" Include monitor reading in 6	foot intervals	O borehole, is	ncrease reading fre	equency if elevated reponse read.	Background (ppm): 4-3
Remarks:					Background (ppm).
Converted to Well:	Yes		No	Well I.D. #: <u>ゴね</u>	4-47-MW/75

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Page ___ of ___

		_	
PROJECT NAME:	CTO 162 / Pesticide Shop	BORING NUMBER: JAX-47-SE17D	
PROJECT NUMBER:	N3966+1Y0050119 HYO	050/15 DATE: 3.25.02	
DRILLING COMPANY:	Ambient (ATI)	GEOLOGIST: L. KNIGHT	
DRILLING RIG:	MOBIL DRILL B-57	DRILLER: LEWIS JOHNSON	

						MAT	ERIAL DES	CRIPTION			PIC	/FID Re	⇔ding ((ppm)
Sampi No. and Type o RQD	(Fl.)	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	(DeptivPt	Soil Density/ Consistent y	Celo	Materi	al Classification	U S C S ·		Sample	Sampler 82	Barehole**	Driller BZ**
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							FOR JAX	-47-SB178						
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							ZAYEY SAN	D; gray tan		split			\perp	_
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				145		(CLAYEY JAN	D]M br.912y		5 PUT 5 700 N	_	_		_
			1	6.5				n/gray etan		SPLITSIOON			_	_
			3	8-5			AND 450A	E CLAY; & M GR		SPLIT SPOON	\bot		_	_
			1	0.5				fan 19ray		SPLIT SPOON	_	_		_
						5	147 SAND	vfl strff		SPIT SPOON		\bot	_	4
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						E	08 = 5	1'615		615				

 When rock coring, enter rock brokens
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"Include monitor reading in 6 foot intervals @ borehole.	Increase reading frequency if elevated reponse read.
Remarks:	

Drilling Area
Background (ppm): 3.4

Converted to Well:	Yes	No	Well I.D. #: <u> </u>

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	Tt	Tetra	Tech	NUS,	Inc.

Converted to Well:

BORING LOG

Page ___ of ___

		MAN		CTO	162 / Pes	sticid	le Shop	BORING N	1UMI	BER: JAX-47-5. 3·19·02 L. KNIGHT	<u>B 18</u> .	<u> </u>		
		NUM		N3966	5+1Y005	7 1	HY0050	GEOLOGI	ST.	1 VALIGHT				
			PANY:	Amble	ent (AT L DUL	1/1	3-67	DRILLER:	.	LEWIS JOHNS	501			
DHIL	LING	RIG:	T	INUDI					T			ÆID D.	eding (
Sample No. and Type or RQD	(Ft.)	Blows / 6" or ROD (%)	Sample Recovery / Sample Length	1	Soil Density/ Consistent y		ERIAL DESC	Classification	Uscs.	Remarks		Sampler 82		Oriller:82**
				0.6 -			TOPS & YGA	12.10012; CM/A						
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When roo	ck corin	g, enter ro reading is	ock broke n 6 foot in	ness. tervals Ø	borehole. Ir	ncreas	e reading frequen	cy if elevated reponse	read.	Drilli	ng Ar	ea_		
indude i Iemark		COURTY I	. C 1001 A1					-		Background	i (ppn	n): [3	?: <u>3</u>	
onver	ted to	Well:	Y.	es es	\angle	N	lo	. Well I.D.	#:_:	JAX-47 - MV	<u> 118</u>	S		

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Converted to Well:

BORING LOG

Page	1	of	

		T NAM	IE: IBER:		162 / Pe		de Shop HYO C50	BORING	NUN	MBER: JA	x-47-5	E18	\mathcal{P}_{-}		
				Ambie	ent (AT	I)		GEOLOG	SIST:	1. KA	<u> IIGHT</u>				
DRI	LLING	RIG:		MOB	IL DRIL	<u>L'B</u>	3-57	DRILLEF		LEW15	JOHN.	50N			
Sample No. and Type o RQD	(Ft.)	Blows / 6" or ROD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Pt) or Screened Interval	Soil		ERIAL DESCE	RIPTION	U S C S ·		narks	Sample 3	Sampler 82	Ederahole**	
							SEP SOIL	BORING							
		$\overline{}$					LOG FOI J	AX-47-							
							MW185 A	or 0-14'							
							bls DESCR	IPTION							
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							SAND W train			CDIHS	PANAL				
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							As Above, Co	CAY CONTENT		(PLIT (MAN				
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indude n Remark	nonitor r	eading in		ervals 0 b	orehole. Ind		reading frequency i			Ba JA×-4 ^r	ckground): 夕	3	_
onvert	ea to	vveii:	Ye	»		IAC	·	Well I.D.	π·	7 <u>~~</u>	, , , , , ,	<u> </u>	<u></u>		

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		MAN T MUN T		CTO	162 / Pes 6 1 1 Y 0 0 5 1	sticid	e Shop HYO 05	50 11	BORING	NOM	BER: JAX-47-5 3.18.02 L. KNIGHT	<u> 19</u>	<u>J</u>		
,				Ambie	ent(AT	ナー	71100-	<u>, </u>	GEOLOG	IST:	L. KNIGHT				
		RIG:		MOB	IL DRILL	B	57		_ _DRILLER	:	LEWIS JOHN	50N	′		
	T	T T					ERIAL DE	SCRII	PTION	T		Pi	D/FID R	eeding	(ppm)
Sample No. and Type o RQD	(Ft.)	Blows / 6" or RQD (%)	Sample Recover / Sample Length	y Change (Depth/Pi	y Soil I. Density Consistent y) Mater	rial Clas	ssification	U S C S ·	Remarks	Sample	Sampler 9Z	Borehole**	Driller.82**
				0.2 -	1		70050K 4/60	米	COND; SAND;	GRAY					
				1			/	T							
				1			SANID	; V. f	ine; pale						
							brownish	yell	ine; pale low be- of 3.61s						
				1			primo	Fon	01 3.615			1			
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No

Converted to Well:

Well I.D. #: ゴスン・47・MW/98

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IT	Tetra	Tech	NUS,	Inc.

Yes

No

Well I.D. #: オタン-47・MM205

BORING LOG

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Sampl No. and Type o RQD	e Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recover / Sample Length	ry Change (Depth/Pt	Soil	cok	D) Materi	al Classification	U S C S .	Rem	arks	ejdung	Sampler 82	
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Tetra Tech NUS, Inc.

BORING LOG

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PROJ				PS.	5 47			. 1. 1	BORING I	NUMBER:	JAX47-	MW	135		
		JMBEF			13966 Tridse				DATE:	IOT.	11-4-02				
		OMPAN	1Y:	<u>Par</u>	Tridge				GEOLOG		A. Pate				
DRILL	ING RI	G:			DRILLER:			M. Nicholson	2						
Sample No. and Type or RQD	Depth (FL) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil			DESCRIF		U	Remarks	Sample	Sampler BZ	Borehole**	
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							Med-	fine Sa	o d				\Box		
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Convert	ed to \bar{V}	Vell:		Yes	V	1	No		W	ell I.D. #:	Jax 47-MW	23.			

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PROJ PRILL		UMBEI 1APMC		PSC 47 N 3966 Paituas				BORING N DATE: GEOLOGIS DRILLER:	Jax 47-MW 24D 11-5-02 A. Pate M. Nichdson J. Weathers					
Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistenc y or Rock Handness			IAL DESCRIPTION Material Classification	U 8 0 8 .	Remarks		FID R	Borehole**	
			· ·	ᆈ			1	med-fine LT. Gray Sands						
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				45'		1	-1/	nestone Rock						
		ter rock bro									-	-	+	

ness.												
* Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.												
Remarks:												
				Background (ppm):								
Yes	X	No	Well I.D. #:	Jax 47-MW 24D								
	ntervals @ bor	ntervals @ borehole. Increasi	ntervals @ borehole. Increase reading frequency if elevated re	ntervals @ borehole. Increase reading frequency if elevated reponse read.								

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	ECT NA		_	<u>PSC</u>	.47		. ~ . ^	BORING N	NUMBER:	Jax 47-MU	175	5		
		JMBEF DMPAN			1966. ITrødse			GEOLOGI	ST:	11-4-02 A. Pate				
	NG RI		4 I .	ra	1119958			DRILLER:	-	M. Nicholson				
DIVICE	110 111	J.	T			AATE	RIAL DESCRI				PID/F	ID Re	ading	(ppm)
Sample No. and Type or RQD	Depth (Ft) or Run No.	Blows / 6" or RQD (%)	or Recovery / QD Sample	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistenc				U S C S	Remarks	Sample	Sampler BZ	Borehole**	Driller 82**
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• When ro •• Include Remar	monitor re	enter roc	k brokenes 6 foot interv	s. vals @ bore	hole. Increa	ase rea	iding frequency if elev	ated reponse read.		Dri Backgrour	lling Ar nd (ppr			
Convo		Mall-		Ves			No	<u> </u>	/eILLD #	Jax 42- MU	1/2 h	· c		

PROJECT NUMBER: DRILLING COMPANY: DRILLING RIG:				Pestideshop BORING NUMBER: DATE: Patridge Drilling GEOLOGIST:						MW 26 1-15-03 MG				
KILLI	NG RI	G:		<u>P1</u>	7 / 1	<u>114t</u>	on Hear	DRILLER:		MIK NI	(hd.	ison	***************************************	
Sample No. and Type or RQD	Depth (FL) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/FL) or Screened interval	Soil Density/ Consistency y or Rock Hardness	Color		sification	J & C & •	Remarks		Sampler 82 22 22 22 22 22 22 22 22 22 22 22 22		
	-			0-4	LtBn	elte	Sitty fine	sand				0		
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	nitor read	ter rock br ing in 6 fo		@ borehol	e. Increase	e readin	g frequency if elevated	reponse read.		Drilli Background	ng Area	0.0	一 刁	

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PROJE				PSC 47 BORING NU 13966 DATE:					IUMBER: JAX. 4+-MW27 - 15.03						
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DIVICE	1	J.		110.10			RIAL DESCRIPTION	PID/FID Read					(mag)		
Sample No. and Type or RQD	Depth (FL) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/FL) or Screened Interval	Soll Density/ Consistenc y or Rock Handness	Color	Material Classification	U	Remarks		Sampler BZ				
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*When m	ck coring	enter rock	(brokeness	L :.		1									
*When rock coring, enter rock brokeness. Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read. Remarks: Background (ppm): 0,0															
Conver	ted to \	Nell:		Yes	X		No	/ell I.D. #:	JAX.47.N	111	LI				